Supplemental Material for 'Clarifying the amount effect' by Moore et. al., 2013

1 Large-scale tendencies

Figure 1 depicts the different terms used to calculate the tendencies of moisture and temperature. The first term represents the vertical advection. The second term represents the horizontal convergence, where the value of $\overline{\chi^*}$ depends on whether there is large-scale convergence or divergence. In cases of large-scale divergence ($\frac{d(\overline{\rho w})}{dz} < 0$), the upwind value of $\chi^* = \overline{\chi}$, which represents the domain average value. However, when there is large-scale convergence ($\frac{d(\overline{\rho w})}{dz} > 0$), $\chi^* = \chi^{ref}$. Here χ^{ref} refers to the reference value that is calculated when the model reaches equilibrium (before WTG initiation) and represents the environment surrounding the convecting column. The final term, horizontal advection of upstream air, is neglected in our calculations because we do not have information concerning the horizontal gradient of isotopes in this region. We thus assume that the isotopologue distribution is horizontally uniform and therefore the advection term is 0.

2 Vertical Velocity Profile

Back and Bretherton (2006) found distinct vertical velocity profiles associated with East and West Pacific locations and we noted in our paper that the structure of the vertical velocity profile could influence the strength of the amount effect as well as the potential role of boundary layer (BL) vapor. In figure 2, we provide the domain average vertical velocity profiles, averaged over each SST regime. Excluding the coldest SST, we find that $\overline{w}$ peaks in the upper troposphere. While we have not investigated this relationship further, it is possible that the top heavy profile could result in a lower δD_v of converged vapor, as convergence will be strongest in the mid-troposphere where vapor is more depleted.

3 Boundary Layer Vapor

A secondary result of our simulations was to find that the isotope ratios of BL vapor and precipitation rates change together. Figure 3 depicts the linear relationship between the δD_p and δD_{BL} values as well as the isotopic ratios of precipitation and BL vapor (R_p and R_{BL}). For the δD_p and δD_{BL} plot, we include the best fit line, which compares well with that in figure 8 of *Kurita* (2013) who found a linear relationship of $\delta D_{vap} = 0.72\delta D_p - 78.55$. We note that here we used the BL vapor for our comparison, which is the average of vapor in the lower 50mb, while *Kurita* (2013) used near-surface vapor. The plot of R_p and R_{BL} is included to demonstrate that we expect to find an $\alpha_{eff} \sim 1.05 - 1.08$ since the R_{BL} values are $\sim$0.9

References

Back, L. E. and C. S. Bretherton (2006), Geographic variability in the export of moist static energy and vertical motion profiles in the Tropical Pacific, *Geophys. Res. Letts., 33*, L17810.

Kurita, N. (2013), Water isotopic variability in response to mesoscale convective system over the tropical ocean, *J. Geophys. Res.,* in press, doi: 10.1002/jgrd.50754.

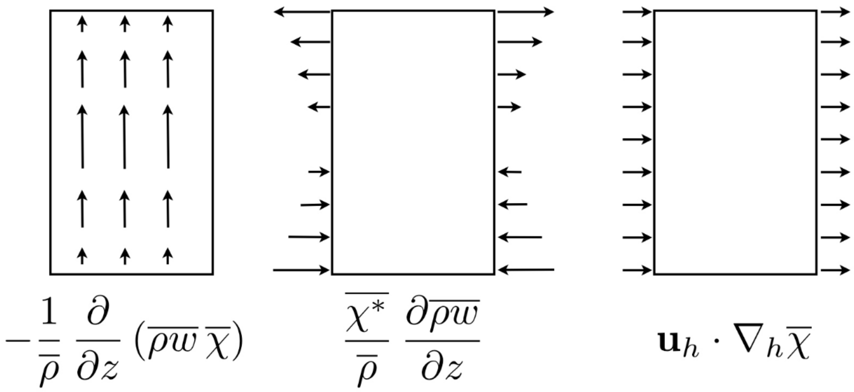

Figure 1: Depicts the three terms used in the calculation of the large-scale moisture and temperature tendencies. From left to right, they are the vertical advection, horizontal convergence and horizontal advection terms.

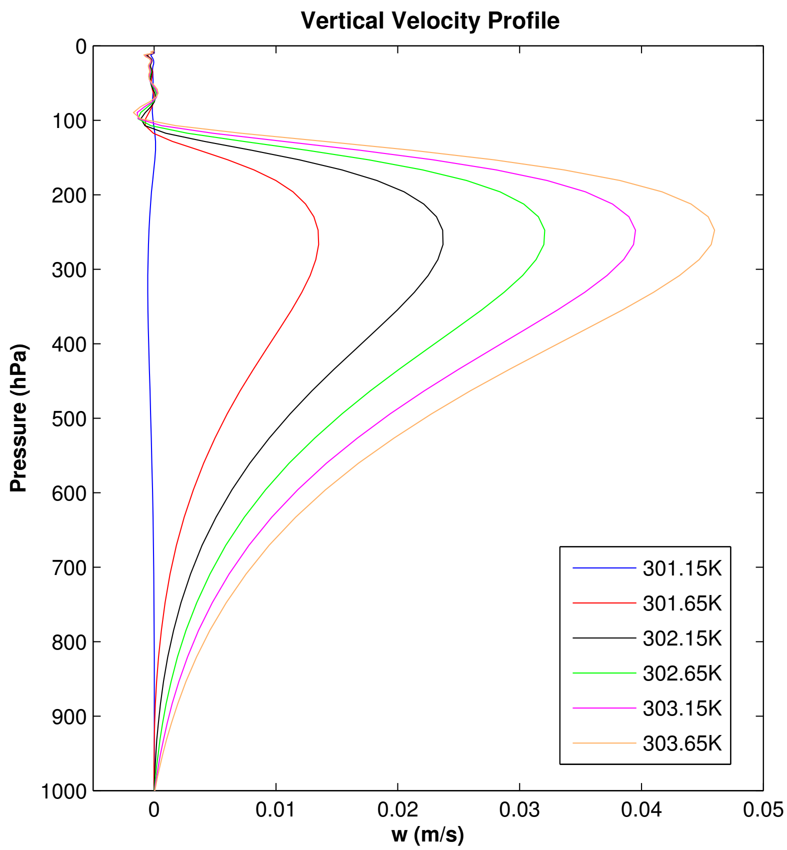

Figure 2: Depicts the domain average vertical velocity profiles for each SST regime.

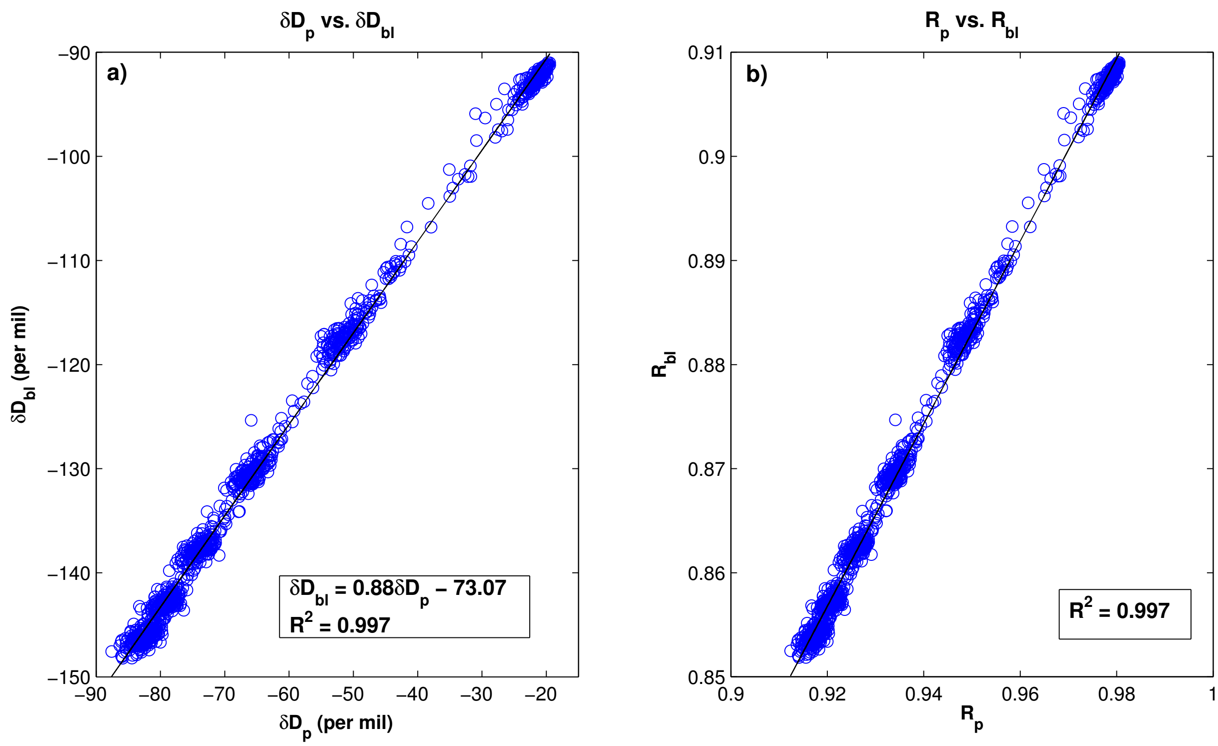

Figure 3: Showing the linear relationship between (a) δD_p and δD_{BL} and (b) R_p and R_{BL}, where R is the ratio of HDO to $H_2^{16}O$. R^2 values are included in both cases as well as the best fit line in (a) for comparison with *Kurita* (2013).